Linear Thermal Expansion of Candidate Reference Materials: Glass-Like Carbon

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Glass-like carbon is a candidate reference material for thermal expansion of solids, in particular, at high temperatures. To estimate the suitability of the glass-like carbon as a reference material for dilatometers, linear thermal expansion data for five samples, which were machined from a glass-like carbon plate, were measured using a laser interferometric dilatometer. The sample was heated and cooled stepwise at temperature intervals of about 50 K to calculate the linear thermal expansion coefficient (LTEC) between equilibrium temperatures. Glass-like carbon exhibits neither permanent length change nor hysteresis of thermal expansion due to the heating or cooling received during the measurement. The standard deviation of the measured values of the LTEC was estimated to be less than 0.2 % for each of all five samples investigated. Expanded uncertainty of the LTEC was calculated based upon the analysis of thirteen uncertainty sources. All the expanded uncertainties at the temperatures investigated do not exceed 1.3 %. The major portion of the estimated uncertainty was contributed by three uncertainty sources associated with the limited accuracy of thermocouple calibration, temperature difference between the sample and thermocouple, and apparent length change due to the temperature distribution within the optics of the interferometer. The present results indicated a glass-like carbon plate commercially available was not so homogeneous in the LTEC.